

Figure 1

*See explanatory note (g)
 **See explanatory note (f)
 ***See explanatory note (h)

NO E-RATE FUNDING AFTER 6 MONTHS

Proposed Type of Expense	# of Sites	6 mo per site cost	1st 6 mo. Jul-Dec 98*	2nd 6 mo. Jan-Jun 99*	3rd 6 mo. Jul-Dec 99*	4th 6 mo. Jan-Jun 00*	5th 6 mo. Jul-Dec 00*	6th 6 mo. Jan-Jun 01*	7th 6 mo. Jul-Dec 01*	Total 3.5 yrs.***
Local Site total costs: (a)										
Sites with < 30 computers	400	\$360	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 1,008,000
Sites with 30-60 computers	1000	\$360	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 2,520,000
Sites with 61-120 computers	300	\$360	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 756,000
Sites with >120 computers	100	\$360	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 252,000
Subtotal for local sites	1800		\$648,000	\$648,000	\$648,000	\$648,000	\$648,000	\$648,000	\$648,000	\$4,536,000
State Backbone & Internet (b)	95	\$10,596	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$ 7,046,340
Any additional Backbone cost (c)			\$110,775	\$48,000	\$48,000	\$48,000	\$48,000	\$48,000	\$48,000	\$ 398,775
Other one-time costs (c)			\$17,538,151	\$198,750	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$ 17,986,901
Other recurring costs (c)			\$5,696,454	\$2,178,630	\$987,380	\$587,380	\$787,380	\$787,380	\$787,380	\$ 11,811,984
Total All Costs (h)			\$25,000,000	\$4,080,000	\$2,740,000	\$2,340,000	\$2,540,000	\$2,540,000	\$2,540,000	\$41,780,000
(sum check) (h)										\$41,780,000
Sources of Payments(d)										
Amount paid by State & Local*** (d.i)			\$1,000,000	\$4,080,000	\$2,740,000	\$2,340,000	\$2,540,000	\$2,540,000	\$2,540,000	\$17,780,000
Amount of Other Funding offered by proposer (d.ii)			\$7,500,000	\$0	\$0	\$0	\$0	\$0	\$0	\$7,500,000
Savings from existing State & Local paid to proposer for expansion (d.iii)			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Discount paid by FCC to proposer (d.iv)			\$16,500,000	\$0	\$0	\$0	\$0	\$0	\$0	\$16,500,000
Total All Payments: *** (d.v)			\$25,000,000	\$4,080,000	\$2,740,000	\$2,340,000	\$2,540,000	\$2,540,000	\$2,540,000	\$41,780,000
(sum check)										\$41,780,000
Total Savings proposed by vendor under current state & local costs (e)			\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Calculations of FCC discount for each 6 mo. Period										
	Disc % **		1st 6 mo. Jul-Dec 98*	2nd 6 mo. Jan-Jun 99*	3rd 6 mo. Jul-Dec 99*	4th 6 mo. Jan-Jun 00*	5th 6 mo. Jul-Dec 00*	6th 6 mo. Jan-Jun 01*	7th 6 mo. Jul-Dec 01*	Total 3.5 yrs***
Costs eligible for FCC discount	66%		\$25,000,000	\$0	\$0	\$0	\$0	\$0	\$0	\$25,000,000
Costs ineligible for FCC discount	0%		\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Sum of all discounts from FCC (sum check)			\$16,500,000	\$0	\$0	\$0	\$0	\$0	\$0	\$16,500,000

*See explanatory note (g)

**See explanatory note (f)

***See explanatory note (h)

NO E-RATE FUNDING AFTER 18 MONTHS

[illegible]

Sources of Payments(d)

Amount paid by State & Local*** (d.i)	\$1,000,000	\$4,080,000	\$2,740,000	\$2,340,000	\$2,540,000	\$2,540,000	\$2,540,000	\$17,780,000
Amount of Other Funding offered by proposer (d.ii)	\$7,500,000	\$0	\$0	\$0	\$0	\$0	\$0	\$7,500,000
Savings from existing State & Local paid to proposer for expansion (d.iii)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Discount paid by FCC to proposer (d.iv)	\$16,500,000	\$7,920,000	\$5,318,824	\$0	\$0	\$0	\$0	\$29,738,824
Total All Payments: *** (d.v) (sum check)	\$25,000,000	\$12,000,000	\$8,058,824	\$2,340,000	\$2,540,000	\$2,540,000	\$2,540,000	\$55,018,824
Total Savings proposed by vendor under current state & local costs (e)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

[illegible]

*See explanatory note (g)

••See explanatory note (f)

***See explanatory note (h)

NO E-RATE FUNDING AFTER 30 MONTHS

Proposed Type of Expense	# of Sites	6 mo per site cost	1st 6 mo. Jul-Dec 98*	2nd 6 mo. Jan-Jun 99*	3rd 6 mo. Jul-Dec 99*	4th 6 mo. Jan-Jun 00*	5th 6 mo. Jul-Dec 00*	6th 6 mo. Jan-Jun 01*	7th 6 mo. Jul-Dec 01*	Total 3.5 yrs.***
Local Site total costs: (a)										
Sites with < 30 computers	400	\$360	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 144,000	\$ 1,008,000
Sites with 30-60 computers	1000	\$360	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 360,000	\$ 2,520,000
Sites with 61-120 computers	300	\$360	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 108,000	\$ 756,000
Sites with >120 computers	100	\$360	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 36,000	\$ 252,000
Subtotal for local sites	1800		\$648,000	\$648,000	\$648,000	\$648,000	\$648,000	\$648,000	\$648,000	\$4,536,000
State Backbone & Internet (b)	95	\$10,596	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$1,006,620	\$ 7,046,340
Any additional Backbone cost (c)			\$110,775	\$110,775	\$116,050	\$142,425	\$142,425	\$48,000	\$48,000	\$ 718,450
Other one-time costs (c)			\$17,538,151	\$2,457,695	\$1,557,695	\$233,253	\$50,000	\$262,500	\$262,500	\$ 22,361,794
Other recurring costs (c)			\$5,696,454	\$7,776,910	\$4,730,459	\$4,852,055	\$5,623,543	\$574,880	\$574,880	\$ 29,829,181
Total All Costs (h)			\$25,000,000	\$12,000,000	\$8,058,824	\$6,882,353	\$7,470,588	\$2,540,000	\$2,540,000	\$64,491,765
(sum check) (h)										\$64,491,765

Sources of Payments(d)

Amount paid by State & Local**(d.i)	\$1,000,000	\$4,080,000	\$2,740,000	\$2,340,000	\$2,540,000	\$2,540,000	\$2,540,000	\$ 17,780,000
Amount of Other Funding offered by proposer (d.ii)	\$7,500,000	\$0	\$0	\$0	\$0	\$0	\$0	\$ 7,500,000
Savings from existing State & Local paid to proposer for expansion (d.iii)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ -
Discount paid by FCC to proposer(d.iv)	\$16,500,000	\$7,920,000	\$5,318,824	\$4,542,353	\$4,930,588	\$0	\$0	\$ 39,211,765
Total All Payments: *** (d.v)	\$25,000,000	\$12,000,000	\$8,058,824	\$6,882,353	\$7,470,588	\$2,540,000	\$2,540,000	\$ 64,491,765
(sum check)								\$64,491,765
Total Savings proposed by vendor under current state & local costs (e)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0

Calculations of FCC discount for each 6 mo. Period	Disc % **	1st 6 mo. Jul-Dec 98*	2nd 6 mo. Jan-Jun 99*	3rd 6 mo. Jul-Dec 99*	4th 6 mo. Jan-Jun 00*	5th 6 mo. Jul-Dec 00*	6th 6 mo. Jan-Jun 01*	7th 6 mo. Jul-Dec 01*	Total 3.5 yrs***
Costs eligible for FCC discount	66%	\$25,000,000	\$12,000,000	\$8,058,824	\$6,882,353	\$7,470,588	\$0	\$0	\$ 59,411,765
Costs ineligible for FCC discount	0%	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$ -
Sum of all discounts from FCC (sum check)		\$16,500,000	\$7,920,000	\$5,318,824	\$4,542,353	\$4,930,588	\$0	\$0	\$ 39,211,765
									\$39,211,765

*See explanatory note (g)

**See explanatory note (f)

***See explanatory note (h)

ATTACHMENT I

Reviewer Questions for ENA Response to RFP 97-2

March 10, 1998

Deliver via email with confirmation phone call to Jackie Shrago (shragoj@ten-nash.ten.k12.tn.us), 615-532-1229.

- 8) *E-Rate Form 471 filing for the first E-Rate period requires a detailed list of services. Please provide sufficient detail for July 1-Dec 31, 1998. Costs for these items will also need to be detailed but should be provided in a separately sealed cost information package which will be opened at the time that the Cost Proposals are opened.*

On July 1, 1998, ENA will provide a basic level of service for all schools. This will include an installed router at each school, which will be connected to a computer or a network of computers at the school. This school router will be connected to an ISDN line; in some cases, the router may be connected to two ISDN lines. The telecommunications lines will be connected to an ENA router in each county. This county router ultimately allows the school's Internet traffic to reach the Internet through a variety of contracted services, which are the responsibility of ENA.

On July 1, ENA will begin providing new service levels, in addition to the basic level of service described above. These levels of services will be paid for in two parts. The "One-Time, Pre-Discount Cost" will be incurred with the installation of new equipment and upgraded telecommunications lines. The second, ongoing charge will be the "Monthly Pre-Discount Cost." Please see the attached Excel spreadsheet for service level rollout schedules and "block 5" of Form 471. These service level charges are consistent with industry standards for what a single school would receive when "connecting to an Internet Service Provider (ISP) or other end-user" (see Block 5 of Form 471 for items in quotation marks). The primary result of these increased service levels will be reliability and response time improvements. ENA believes these levels of service and the detail provided will be sufficient to complete Form 471. In the event it is not sufficient, ENA will provide any details necessary.

Each new service level impacts all K-12 schools because each upgrade affects the Internet traffic on the entire network. Therefore, the overall performance of the entire network is improved.

Service Level	Description
1	Basic network delivered to all 1600 schools includes connections of school computer or network to an ENA school router, which is connected to an installed ISDN line. The school is connected to an ENA education County Router, which is connected to the Internet through an ENA contracted service. ENA Service includes Help Desk maintenance, ISDN line costs and overall service management. All provided on July 1, 1998.
2	Installation of Education Hub Sites, firewalls, caching servers, installation of upgraded Help Desk monitoring tools, etc.
3	First-month service level upgrades: includes Dual ISDN connectivity, CDS line installations, school routers associated with bandwidth upgrades, school and metro caching, ECR router upgrades.
4	Second-month service level upgrade: includes Dual ISDN connectivity, CDS line installations, school routers associated with bandwidth upgrades, school and metro caching installation, ECR router upgrades.
5	Third-month service level upgrade: includes Dual ISDN connectivity, CDS line installations, school routers associated with bandwidth upgrades, school and metro caching installation, ECR router upgrades.
6	Fourth-month service level upgrade: includes Dual ISDN connectivity, CDS line installations, school routers associated with bandwidth upgrades, school and metro caching installation, ECR router upgrades.
7	Fifth-month service level upgrade: includes Dual ISDN connectivity, CDS line installations, school routers associated with bandwidth upgrades.
8	Sixth-month service level upgrade: includes Dual ISDN connectivity, CDS line installations, school routers associated with bandwidth upgrades.

See creativity section of ENA RFP Technical response, pages 60-64.

ENA Monthly Service Levels							
One time system delivery or upgrade of service							
							Total
Level of Service-One Time Costs	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	1st Six Months
Service Level 1 - Basic Network	7,950,000						7,950,000
Service Level 2	1,845,546						1,845,546
Service Level 3	1,790,552						1,790,552
Service Level 4		1,691,151					1,691,151
Service Level 5			1,207,140				1,207,140
Service Level 6				1,207,140			1,207,140
Service Level 7					1,134,489		1,134,489
Service Level 8						858,234	858,234
Service Level 9							-
Service Level 10							-
Service Level 11							-
Service Level 12							-
Service Level 13							-
Service Level 14							-
Service Level 15							-
Service Level 16							-
Service Level 17							-
Service Level 18							-
Total One-Time Charges	11,586,098	1,691,151	1,207,140	1,207,140	1,134,489	858,234	17,684,251
Ongoing Service levels							
Service Level 1							-
Basic Service	108,000	108,000	108,000	108,000	108,000	108,000	648,000
Basic Internet Access	167,770	167,770	167,770	167,770	167,770	167,770	1,006,620
Service Level 2	210,253	201,716	193,179	184,641	176,104	171,418	1,137,311
Service Level 3	222,492	131,064	131,064	131,064	131,064	131,064	877,811
Service Level 4		274,530	148,546	148,546	148,546	148,546	868,712
Service Level 5			293,081	132,539	132,539	132,539	690,699
Service Level 6				371,818	176,719	176,719	725,256
Service Level 7					478,781	249,125	727,906
Service Level 8						633,433	633,433
Total Recurring Charges	708,515	883,080	1,041,639	1,244,378	1,519,523	1,918,615	7,315,749
Total Monthly Charges	12,294,612	2,574,230	2,248,778	2,451,517	2,654,012	2,776,849	25,000,000

**ENA PROPOSAL
OVERVIEW FOR SCREENING PURPOSES**

	<u>TOTAL</u>	<u>PER STUDENT</u>	<u>PER COMPUTER</u>	<u>PER SCHOOL</u>
		900,000		
			90,000	1,600
TOTAL CONTRACT	\$ 74,352,941.00	\$ 82.61	\$ 826.14	\$ 46,470.59
PER YEAR AMOUNT	\$ 21,243,697.43	\$ 23.60	\$ 236.04	\$ 13,277.31
PER MONTH	\$ 1,770,308.12	\$ 1.97	\$ 19.67	\$ 1,106.44
PER HOUR PER STUDENT PER WEEK		\$ 0.16		

The goal is to provide every student with 3 hours access per week.

The above numbers are provided for your review. Form 471 provides space to put the number of schools, students and computers expected to be served by the contract. The Schools and Library Corporation is expected to use screens to determine if the contract provides service at or below industry pricing standards. We believe our per-student, per-computer, and per-school costs are lower than industry standards and will meet the requirements of the FCC screen.

As a comparison, a month-to-month price for providing BellSouth.net Frame Relay service at 384Kbps with no guaranteed bandwidth (0 CIR) is \$1,694. ENA's proposed per school price of \$1,100 per month, including guaranteed service levels for web page delivery and full maintenance and support, demonstrates the economies of our program. ENA's caching and support services also improve the reliability of site-specific access.

ATTACHMENT J

STATE OF TENNESSEE

PROPOSALS

REQUEST FOR

Current Expenditures

<u>Type of Expense</u>	<u># of Sites</u>	<u>Annual Cost</u> <u>Per/site</u>	<u>Current annual</u> <u>Expenditure</u>	<u>Current Cost</u> <u>per local site</u>
Local Site connection:				
Sites with < 30 computers	400	\$720.00		
Sites with 30-60 computers	1000	\$720.00		
Sites with 61-120 computers	300	\$720.00		
Sites with >120 computers	100	\$720.00		
Subtotal for local sites paid by Local Educ. Agencies	1800		\$1,296,000	\$720
Equipment Maintenance:				
Sites with < 30 computers (a)	400	\$245.00		
Sites with 30-60 computers	1000	\$245.00		
Sites with 61-120 computers	300	\$245.00		
Sites with >120 computers	100	\$245.00		
Subtotal local site maint.	1800		\$441,000	
Subtot: ECR maint: 1/county (b)	95	\$4,850	\$460,749	
Subtotal: all maintenance			\$901,749	\$501
Network Operations:	1800			
Operations hardware, software and personnel		\$825,000		
800 line for end users		\$15,000		
email server maintenace		\$30,000		
Subtotal: all network operations			\$870,000	\$483
State Backbone & Internet (connection: 1 per county) (b)	95	\$21,192	\$2,013,200	\$1,118
Total paid by State Dept of Educ.			\$3,784,949	\$1,704
Total State & Local: 1 year * (c)			\$5,080,949	*approx. 100
Total paid by State: 3.5 years			\$13,247,322	sites are paid
Total State & Local 3.5 years			\$17,783,322	entirely by local sources

<u>Services Eligible for FCC funds</u>	<u>Disc %</u> (d)	<u>Eligible</u> <u>Amount</u>	<u>Discount paid to</u> <u>Contractors by FCC</u>
Current ConnectTEN Costs	66%	\$5,080,949	\$3,353,426

Note: Based on FCC rules for existing contracts, this is the amount that is being prorated for 6 months and submitted for reimbursement to current vendors. See example in Section 6.2.7 for cost formula used in evaluation. It is proposer's responsibility to determine E-rate payment and eligibility

ATTACHMENT K

5.2.4 Technical Approach

The Proposer shall describe the vendor's plans and approach for accomplishing the work requested. The information provided shall be in enough detail to enable the State to ascertain the Proposer's understanding of the effort to be accomplished and should outline the steps in the total service proposed. Technical Proposals shall provide the following narrative information (referencing the subsections in sequence) to evidence the suitability of the Proposer's technical approach to delivering the services sought under this RFP:

5.2.4.1

Proposers must provide a comprehensive narrative, captioned "Project Understanding," that illustrates the vendor's understanding of the State's requirements and project schedule.

Additional information which supports ENA's project understanding are included in sections 5.2.2.2, 5.2.2.3, and 5.2.2.4.

Project Understanding

Education Networks of America (ENA) understands the goal of the Tennessee State Department of Education is to expand the functional capabilities of the ConnecTEN network in order to improve instructional opportunities for all K-12 students and teachers. Therefore, ENA's technical design is focused, not merely on how to upgrade the network, but instead on what those upgrades will provide to students and teachers.

ENA ensures that the following State-specified requirements, as outlined in Section 1.1 of this RFP, will be met. ENA's approach is listed under each State requirement:

- *Provide fair and equitable access to the Internet for all K-12 schools.*
 - ◆ A scaleable migration plan prioritized by student population *and* matching PC count ensures that all schools receive an appropriate share of resources.
- *Expand the capabilities realized by all PCs.*
 - ◆ Network-wide enhancements such as centralized caching servers improve response time of all schools.
 - ◆ Specialized content services introduce grade- and subject-specific menu options that teachers can use for the development of lesson plans and identification of subject resources. These content services will provide access to a wide array of curriculum enhancement products.
- *Use creativity to develop funding-driven migration plans.*
 - ◆ Provide rapid ramp-up of infrastructure during first 18 months of likely E-Rate funding.
 - ◆ Provide a flexible strategy that leaves 75 percent of Education County Router ISDN infrastructure in place, if fallback position is required.
 - ◆ Apply specialized knowledge of Universal Service Fund mechanisms to obtain the maximum amount of available E-Rate funding and to remain flexible in the changing funding climate.

- *Deliver as much functionality as possible in providing bandwidth, network equipment, network software, and network operation management.*
 - ◆ Bring 100% of schools to a service level of 2 web pages per minute service level within 18 months by using a combination of bandwidth, caching, and DNS enhancements.
 - ◆ Enhance Domain Name Service (DNS) response time by installing K-12 DNS servers at EHS under the OIR DNS structure.
 - ◆ Replace all Cabletron routers with new routers scaleable from 128K to T1.
 - ◆ Install 2Mbps-45Mbps egress point from ENA CDS/TNII backbone to each Education Hub Site (EHS) providing improved access to the Internet and to caching servers at EHS.
 - ◆ Distribute E-mail servers to each EHS across the state to provide responsive E-mail access for teachers and administrators. Support "next level" E-mail to districts that wish to utilize locally managed directory services.
- *Maximize security and reliability.*
 - ◆ Install firewalls at Internet ingress points to protect entire ConnectTEN network.
 - ◆ Upgrade schools from dial-up to highly reliable, dedicated data access circuits, according to the ENA Scalability Plan.
 - ◆ Replace all Cabletron routers with new routers that are scaleable from 128K to T1.
 - ◆ Use reverse caching to answer inbound requests for school web sites at the Education Hub Sites.
- *Minimize lack of network availability.*
 - ◆ Provide bandwidth upgrade options that are available in all 95 counties.
 - ◆ Provide comprehensive Help Desk services, managed by Lucent Technologies.
 - ◆ Provide statewide field service. Lucent provides 2- and 4-hour response time for any school in the state.
 - ◆ Utilize Lucent's state-of-the-art monitoring tools at ConnectTEN NOC, e.g. Optivity, HP Open View, and Spectrum.
 - ◆ Install new, highly reliable routers at all schools and ECRs.
- *Maintain dial-up local calling in each county.*
 - ◆ Include full utilization and funding for OIR backbone at all 95 county TAPs.
 - ◆ Maintain tacacs authentication server and enhance capabilities, as necessary.

Analysis of Current Status

The original ConnectTEN network was designed for 5,000-10,000 computers connecting to the Internet. Today more than 900,000 students have high-speed (128K per second) access from approximately 40,000 computers in 1,560 schools statewide – exceeding the original design specification by four to eight times. The existing routers are not upgradeable and are no longer produced or distributed by the manufacturer. The state is exposed to a premium risk to maintain and repair this equipment.

To reach most educational web sites, each request at a desktop computer must traverse the school LAN, the ConnectTEN network, the Internet, and the serving web site to retrieve information. The schools need to add approximately 50,000 more computers to meet the governor's goal of three hours of access per student.

The network is maintained through state and local funding totaling approximately \$5 million annually. Upon completion of the current RFP process, the State will submit application for discounts provided through the FCC E-Rate Universal Service orders. Available E-Rate discounts will substantially increase the network's financial resources for multiple years.

ENA Proposal

The vision that drives our technical and business models parallels the functionality of a library visit. It must be simple and easy to use. It must be reliable, and it must be accessible. ENA's goal is to build a ConnectTEN network that:

- Delivers a minimum of two web pages of information per minute for each student
- Supports the PC count required to provide students an average three hours of Internet access per week.
- Facilitates the use of the Internet by all students and teachers.
- Provides enhanced security for the ConnectTEN network.

The following chart compares current network service levels with ENA's proposed targets:

Existing vs. Proposed Services

Services / Functionality	Existing Network	ENA Proposed Network
Connectivity	Single ISDN connection to each school (128Kbps)	90% of schools with bandwidth upgrades using a combination of scaled CDS, dedicated T1 and dual ISDN.
Student-to-computer ratio	22:1	10:1
Average Student Access Time	1 hour weekly @ 1/2 screen per minute	3 hours weekly @ 2 web pages per minute
Organize web-based content	200 bookmarks	Homepage with easy-to-use web-based resources, e.g. encyclopedias, newspapers, discussion groups. Information categorized by grade level and subject.
Equity of access	Driven by bandwidth equity	Driven by performance equity
IP addressing	Static, manual input slows response time because addresses not assigned on regional basis	Address automatically assigned from router (DHCP). Will provide support for current, static IP addressing.

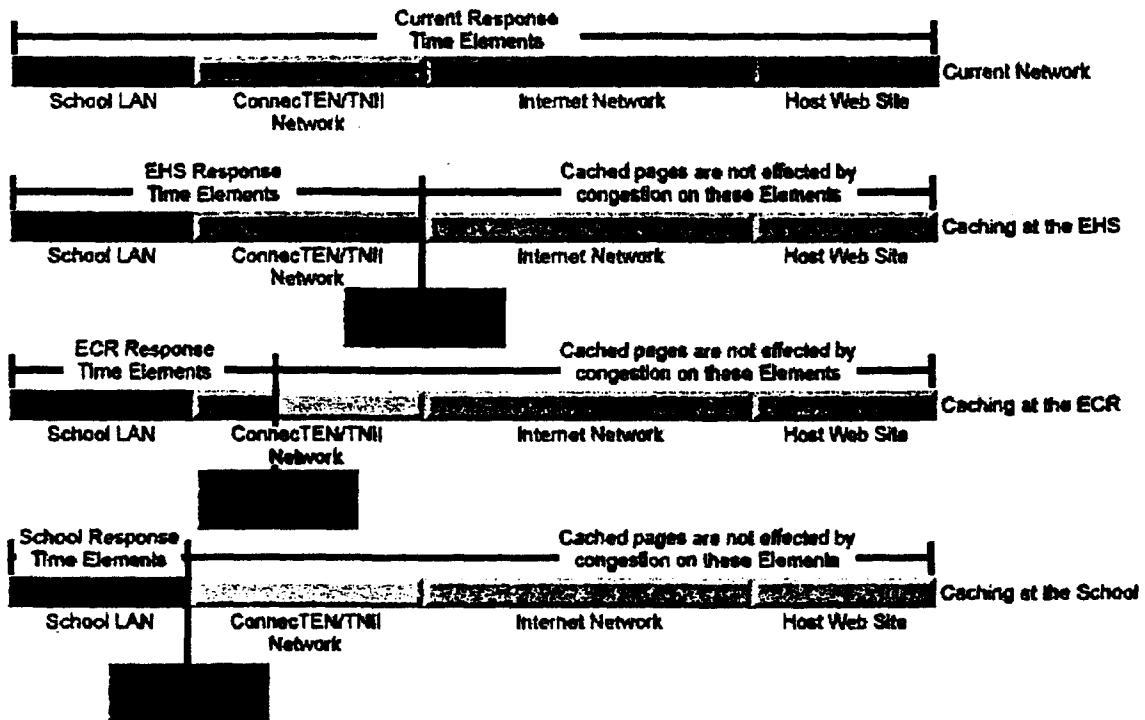
Improved Response Time

ENA will use a dynamic strategy of installing caching servers and increasing bandwidth to improve the response time for all K-12 schools.

Caching

To use the library visit analogy, a teacher who uses the library as a resource tool can reserve materials for her class. This ensures that the material the students must access will be available at the time allotted. One of the challenges with so many users is the possibility of multiple requests for the same web page.

ENA's proposed network creates a "virtual reserve desk" at the vast Internet library. As a teacher plans the next day's lesson and accesses a web site, the information will be stored in a caching server. Therefore, the information will be easily accessible and available when students request the same web page during their lesson. Additionally, the list of bookmarks currently available on the ConnectTEN homepage will be updated and stored daily at caching servers located at the Tennessee Network Information Infrastructure (TNII) regional hub level, county router level, and/or school.



Effects of Caching

In the chart above, the caching servers are virtual reserve desks that store frequently used web pages. Using the library analogy, a student does not need to walk through the stacks of the library looking for another copy of a frequently used webpage. Rather, he or she will simply go to the virtual reserve desk and find their own copy reserved.

The caching strategy effectively reduces the amount of time it takes to retrieve information from the Internet. The State of Utah uses this caching strategy in a similar environment. Based on the State of Utah's experience, ENA projects a 74 percent hit rate on the caching server, which means those requests do not need to actually go out on the

Internet. The result is an improved response time without the need to upgrade equipment at the desktop.

Bandwidth

In addition, ENA's proposal to upgrade bandwidth from ISDN service to Connectionless Data Service (CDS) and point-to-point T-1 service will improve response time. The upgrade is analogous to widening a road so more cars can travel on the road simultaneously. The upgrade of communications lines will reduce delays and improve response time for teachers and students.

Bandwidth upgrades within the ConnecTEN network do not alleviate the potential of bottlenecks once a student's request leaves ConnecTEN and enters the Internet superhighway. However, the deployment of caching servers reduces delays associated with accessing and traversing the Internet.

Improved Reliability

ENA proposes to improve the reliability of the ConnecTEN network by:

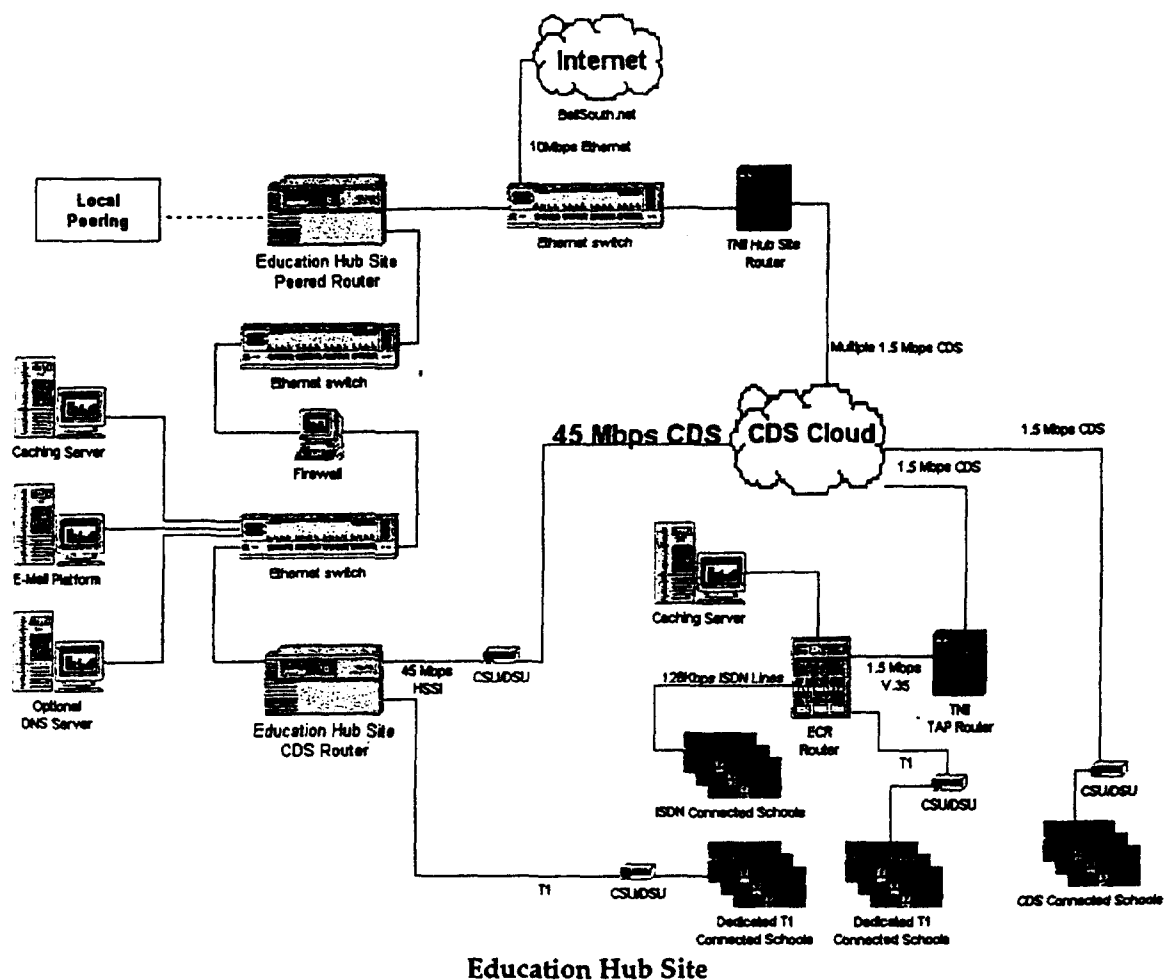
- Implementing Education Hub Sites (EHS)
- Upgrading the Communication Lines in schools according to the ENA Scalability Plan
- Installing Caching Servers at ECRs and large schools according to the ENA Scalability Plan

Because the number of requests will increase in larger schools and school districts (based on student and PC population), ENA proposes installing caching servers in all but the smallest counties between the Education County Router (ECR) and the county Tennessee Access Point (TAP). ENA also proposes installing caching servers in the largest schools that require both T1 and CDS to meet the response time goals.

In effect, the caching servers will create additional virtual reserve desks in high volume areas to re-direct traffic efficiently and effectively. Improved response time and reliability in accessing requested information increases the viability and functionality of the network as a resource tool for both teachers and students.

Education hub sites

The current network will immediately be upgraded with Education Hub Sites (EHS), residing in the five state LATAs and co-located with TNII's five regional hubs (please see section 5.2.4.2.2 Scalability and Key Services Appendix F). An Educational Hub Site (EHS) is our term for a protected area that is similar to a sandwich (See diagram below). Two large routers, one facing the Internet, the other facing the ENA/TNII CDS cloud, make the "bread." The meat inside consists of a firewall, caching server, mail server, and K-12 DNS servers.



Each Education Hub Site will have routers, a caching server, and a firewall that provides customized virtual reserve desks, custom security and E-mail access without affecting traffic from other state agencies. This work will be carefully coordinated with the state Office for Information Resources (OIR).

Communication Lines

The installation of CDS and dedicated T1 will improve reliability of the communications network because dedicated data service performance levels are higher than the existing ISDN performance levels. Dedicated data services such as CDS are continuously monitored by BellSouth's Data Customer Support Center (DCSC) and consistently achieve circuit availability levels of 99.98 percent. The new 2Mbps - 45Mbps CDS egress to EHS hub sites will create a large pipe to the Internet, caching, and other K-12 services at the EHS.

Caching Servers

Because the number of requests will increase in all schools and school districts (based on student and PC population), ENA proposes installing caching servers at the Education County Routers (ECR), and to selected schools, according to the ENA Scalability Plan.

Improved Ease of Use

The vision developed by ConnectTEN's initial design team, including current ENA team members, was targeted for people who have limited technical or computer skills. The concept, called "Three Clicks and You're Out on the Internet," was designed so that a teacher or student could learn within five minutes to access the Internet. Easy-to-use and easy-to-install software contributed to the rapid growth of the network to 40,000 computers.

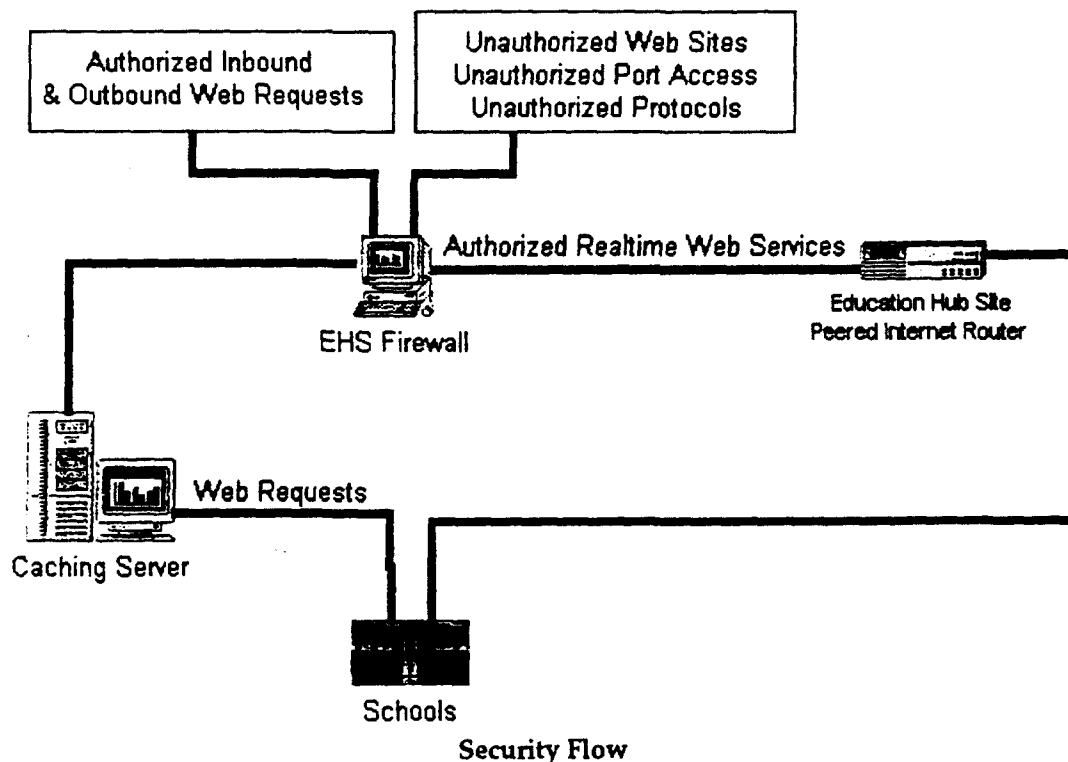
ENA recognizes that for many teachers, **HARDWARE + SOFTWARE + CONNECTIVITY** does not equal a useful, classroom resource that can be utilized on a day-to-day basis.

To respond to this concern, ENA proposes web-based education content services that require minimal training to use. The approach builds on ConnectTEN's current bookmark system of 200 sites. ENA will develop a homepage that offers K-12 educators and students access to a variety of web-based tools, e.g. curriculum development resources, educational publications, dictionaries, encyclopedias, newspapers, homework helpers, museums, libraries, and state and national discussion groups.

ENA will establish a team, called the ENA School Partners, responsible for making on-site visits and gathering feedback from teachers. Consistent interaction will ensure network services and features are responsive to teacher and student needs.

Safety & Security

Educators, parents and legislators are concerned with hackers entering school networks. ENA's proposal offers centralized main security services at the Education Hub Sites (EHS) so that every school, regardless of financial ability or technical resources, will have high-end, professionally managed Internet security.



Individual schools concerned with entry from unauthorized sources via the Internet will have a high degree of protection without the need to implement their own individual network firewalls. Content filtering on a network-wide basis can be implemented upon request from SDE to meet any legal or policy requirements for such filtering.

Equity of Access

Since the inception of the current network, a cornerstone rule has been that funding and resources will be distributed equally and fairly among all Tennessee schools. This RFP for network management maintains the equity requirement. ENA believes the equity standard should move from an equity of bandwidth standard to an *equity of performance* standard. ENA's equity approach is to establish a performance standard for all schools (i.e., two web pages per minute) and then scale bandwidth and response time enhancements according to a school's need.

5.2.4.1.1 Scalability

Maximizing Internet bandwidth and capability within the given budget constraints is a key objective of the ConnectTEN upgrade. The State currently has approximately 40,000 computers on the ConnectTEN network in approximately 1,800 locations. The number of computers at these locations could easily grow to 100,000 or more during the contract period. Proposers should define how their proposed solution scales to satisfy growing bandwidth and capability requirements of each school and of the network. The proposer should define the technical rationale and priority of changes to the existing network. The proposer should also define the functionality, equipment and bandwidth of each site as it is proposed to change and the criteria for causing the change.

ENA intends to employ an aggressive upgrade schedule of network-wide and school-specific enhancements as soon as the 1998 E-Rate funding is approved. ENA's scalability plan takes into consideration the funding level and then applies a priority scheme to ensure that network-wide enhancements are introduced first, followed by specific enhancements to individual schools.

ENA will provide an array of network enhancements that will provide all students with improved and adequate access to the Internet. Our approach maintains a fairness standard across all K-12 schools. The following technical enhancements will be introduced within the first 6 months and will improve access for every student:

Network-Wide Enhancements

- 1) Education Hub Sites (EHS), co-located at Office of Information Resources (OIR) Hub sites, will be installed to provide network-wide caching of web sites and network-wide security.
- 2) Domain Name Services (DNS) servers will be installed at EHS hub sites under the OIR DNS authority. The new servers will provide faster response times for DNS resolution.
- 3) Caching Servers will be installed at Education County Routers (ECR), according to the ENA Scalability Plan, to relieve congestion between the ECR and TAP.
- 4) Internet routing enhancements will be established to improve access to the Internet itself.

School-Specific Enhancements

- 1) ENA will install scaleable routers supporting 128K to T1 bandwidth. Additional enhancements will be added over the life of the contract as demand requires and as E-Rate or other supplemental funding remains available.
- 2) ENA will install caching servers at schools to improve response times, according to the ENA Scalability plan listed in the Scalability chart.

Scalability Assumptions

All of the recommendations for upgrades are based on the following assumptions:

- 1) The current network has an average student-to-PC ratio of 22:1, providing a theoretical average access level of 90 minutes per student per week based on a 7-hour school day.
- 2) The current average response time of a timed test is 1/2 to 1 web page per minute.
- 3) Access to popular Internet education sites are subject to delays and time-outs during prime teaching times.
- 4) The network will support an average of 3 hours of Internet access per week per student.
- 5) A student-to-PC ratio of 1 PC per 10 students is necessary to meet the 3-hour goal.
- 6) True functionality of the Internet occurs when the network can consistently deliver a minimum of 2 pages per minute during the periods of highest education web site

demand. Average education web page is assumed to be 50K-75K bytes with 10 elements.

- 7) Network bandwidth prices are dropping for dedicated data services. New network access technologies with even greater economies of scale are coming rapidly, making flexibility important.
- 8) Experience in other states has shown that schools will most likely increase web usage 25-50 fold in the next 18 months as Internet resources become more functional and access is increased.
- 9) **The next 18 months will be a period of stabilizing new funding sources for an expanded network. The network scalability plan must reflect realities of the financial environment until a new funding paradigm is realized.**

In order to reach an average access time of 3 hours per student per week, the current computer count of the network must grow to 90,000 computers, or approximately twice the current network size. **However, achieving any level of student access time is not meaningful unless a corresponding level of usability is also provided.** ENA believes that this minimum functionality for teaching purposes is 2 web pages per minute, regardless of time of day and traffic conditions on the Internet.

A cursory examination of the problem may lead to the conclusion that slow response time can be resolved simply by expanding the connectivity to the Internet. This conclusion is false and can lead to unnecessary, excessive bandwidth expansion at individual schools as well as at the Internet egress points. Expanded bandwidth by itself will not resolve the unpredictable nature of the Internet and its inability to reliably deliver content. An understanding of what educators are trying to do at the classroom level is necessary to determine the proper approach to providing a real level of functionality.

No amount of expanded bandwidth to the Internet will overcome the fact that education sites are extremely popular and, consequently, extremely busy at critical instruction times during the day. This condition creates a less predictable, less reliable tool for teachers. Teachers will not utilize Internet resources in curricula until those resources are available when they need them in a regular predictable manner.

In order to achieve a predictable delivery system for web content, the Internet must be brought to the school, rather than the school going to the Internet. Caching technology is the key to making this possible for the entire ConnectEN network on a fair and equitable basis. This is achieved in ENA's network design by the extensive deployment of caching servers and expanded bandwidth to access these servers.

ENA plans enhancements in the following priority order, with accompanying rationale. Further technical details concerning a particular service or strategy, such as caching or CDS, may be found in the Key Services Appendix F: